SELECTIONS

FROM THE

RECORDS OF THE GOVERNMENT

OF THE

PUNJAB AND ITS DEPENDENCIES.

NEW SERIES—No. XXI.

NOTE

ON

COAL AND IRON IN THE PUNJAB.

Lahore:

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AS REPORTED BY
Dr. Fleming
M. Macandies
Col. Taylor.
Dr. Oldham.
Mr. Johnson.
BEDS OF COAL
E. E. OLIVER.
M. Inst. C. E.
26-3-85.
Scale 1 Inch=16 Miles.

No 3
DHAULADHAR RANGE
CHOTA BANGAHAL
TRILOKINATH
Pass Pathankot
BHARMOUR
DUNERAIN
IRON ORE SITE
COAL DO
SCALE 4 MILES = 1 INCH
E. E. OLIVER
M. Inst., C. E.
26-3-92.

SELECTIONS

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NOTE

ON

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In a recent note by Mr. Molesworth on iron manufacture in India, the possibilities of the development of any such industry in the Punjab were briefly but clearly summed up. After going through a great mass of references and reports on the subject, there appears very little to be said beyond amplifying what has there been concentrated into two or three paragraphs, and as the very limited economical possibilities of such industry in this Province are pretty generally known, there is but small satisfaction in enlarging on what can at best have but a negative interest ; but it may still be useful to bring together what available information on the subject there is. Admitting the existence of certain iron ores in many parts of the Punjab, the great and insuperable obstacle to the establishment of any iron industry on a scale sufficiently large to be profitable is the want of fuel. In the absence of great forests from which a plentiful and continuous supply of timber or charcoal might be drawn, the only hope would be the discovery of a workable supply of coal, and any review of the subject that did not consider the coal possibilities would be incomplete. The two minerals may therefore be considered together.

2. A very slight acquaintance with the geological formation of the wide level Punjab plain will suffice to limit the probable discovery of either to the surrounding hill ranges; but in almost every hill region round, iron exists in one form or other, and in some cases ores of singular purity. In a few, the manufacture, to a limited extent, has been carried out for long periods; the only reason the industry has not developed, being the before-noted scarcity of fuel, and, recently, the competition of English iron, which has driven the more expensive charcoal-made iron out of the market.

3. It may be convenient to consider these regions with reference to the principal mountain ranges or groups into which they are physically divided.

Sub-Himalayan Range Iron.

4. Beginning with the North-Eastern frontier, iron ore is found almost all along the Sub-Himalayan group from the Jumna to the Ravi. Occasional specimens of the red oxide or red hæmatite have been reported; but the usual form is a magnetic and micaceous ore, often described as magnetic iron sand, and which appears, according to Mr. Medlicott, to be found in rocks of metamorphic origin, the most noticeable and extensive deposits occurring at or near the base of the mountains. In most of the sites examined, these magnetic ferruginous grains seem to be derived from the decomposition of the schists forming the mass of the rock above. Decomposition operates slowly, and of course mainly at the base of the mountain where the *débris* is more exposed to the action of water, either from the rains or melted snow. In some cases the quantity obtainable is very limited, the decomposed schists yielding so small a percentage of iron as to give a bare return for the labor involved in washing, while others are comparatively rich, and samples examined by M. Marcadien yielded from 30 to 40 per cent. The separation of the grains of iron ore from the matrix involves pounding and washing, but the process is simple, easy, and inexpensive. The schists are usually very friable, easily quarried, and water-power is available near most mines, in which the mineral can be washed, and the crystals of oxide, being heavier than the earth, are easily separated. Of the excellence of this iron there is no doubt. Many mines have long been famous, a rude method of smelting having been handed down for generations: an indigenous anticipation of the Bessemer process, involving an extravagant use of charcoal, but producing a metal of the finest quality and well adapted to the native wants. The ore is eminently suitable for the manufacture of iron of the Swedish character, or for what is technically known as "Wootz," a fine kind of steel. Excellent specimens of manufactured iron have been turned out from Náhan, Mandi and Kángra. Specimens sent Home from the latter place in 1858, and tested at the works of Messrs. Sharp, Stewart and Lloyd Forster, compared most favorably with the best qualities of English hammered and charcoal-iron, the tests giving results superior to either. This form of iron has been found at many places throughout the range, as far up as Jummoo, where the Pír Panjál may be said to begin, and where the metamorphic series changes into the sub-metamorphic.

5. There were ancient works at Kalsi on the Dehra Dún side of the Jumna. At Náhan the Rája of Sirmúr has established iron blast-furnaces, and, in addition to a foundry, recently contemplated, experimental rolling-mills. The outturn from the foundry is given by Mr. Ball at about 50 tons per week.

6. In the Suket, Dhámi and Kot Khái States, at Rámpur and Shele in the Bashahr State, are mines that have been worked at one time or other. In the Jubal State, M. Marcadien, a Geological surveyor, who was deputed in 1853, describes 3 or 4 mines feeding 20 to 25 smelting-furnaces in villages near, and similarly mines in the Mandi State with numerous furnaces in 6 villages, particulars regarding which, and the percentage of oxides in the shales, are given in the Selected Punjab Records, No. 117, for 1862.

7. The well-known mines in the Chota Bangáhal Valley and Kohad, in the Kángra District, have been worked at least from the Sikh times. Dr. Warth, in a report submitted to Government in 1873, instances 8 villages with 85 furnaces, and M. Marcadien, in his report of 1853, several others with 116 furnaces in all, each turning out on an average 4 maunds of iron monthly. This, if the figures are reliable, would amount to about 200 tons annually. Dr. Warth, however, puts the figures at only 2,000 maunds.

8. Proceeding north, some rather poor schists near Dharmsála formed the subject of a report; and some mines have been worked in the Chamba State at Bhandal on the Siul river, a tributary of the Ravi. Others of more importance occur again at Riási, 20 miles above Jummoo, in the Kashmír State, and one or two of less note in the same State occur at Sorif Kutyar and Púnch (on the Púnch river) concerning which information is scant. The last, though the ores are of the same character, appear to belong rather to the Pír Panjál.

9. From Bulakot, on a spur in the Hazára District, a rich red hæmatite has been obtained.

10. Similar mines are said to exist in Kulu; but of authentic information there is very little. Mr. Calvert reported large quantities of iron as brought in from the neighbouring States for sale at the annual fairs; but from where is not stated.

11. Further examination might, no doubt, add to the number of these localities with similar mines; but, like the above, more or less unfavorably situated, being buried among lofty mountains to which the only roads are often the merest foot-tracks.

Coal.

12. As far as all observation has gone at present, it may be said there is no locality in the whole of this range of hills where a supply of coal is found, and geologists unite in opposing all hope of any. Mr. Medlicott mentions two groups of rocks in which supposed coal discoveries have been made; the sandstones of the lower hills and the black shaly rocks beneath the limestones of the zone that fringes the higher hills. Certain nests and bands of lignite admittedly occur, and in places there may be a local accumulation; but after examining many scores of sections he comes

to the conclusion that in the region from Naini Tál to the Ravi there was no true coal whatever. At Siláni under Náhan some seams of half an inch to 3 inches were discovered; similarly some small accumulations in the Káláuála or Timli pass at Dharmkot near Dharmsála and Gopipur in Kángra. These have been indicated on sketch map No. 1, but are only interesting to the mineralogist, and may be omitted entirely from any economic consideration.

13. Mr. Medlicott, in reviewing the whole question in his monograph on the range, while anxious not to deter any explorer from further investigation, points out that the result of experience is unfavorable to the prospect of coal being found in any useful quantities.

14. In some of the tertiary rocks of the higher Himalayan range there is of course a possibility of development, and one or two localities, as Dandli on the Púnch and the Sanjar Marg mountain, have been indicated among others as favorable; but if even coal existed, the position seems beyond the limits of any economic working. It may therefore be assumed that an iron industry in the Lower Himalayas can only be confined to charcoal-made iron.

15. The Náhan State may be taken as a fair example of the probabilities of this becoming a commercial success. The Rája has within his own territory both the ore and the flux with somewhat extensive forests for charcoal; but there are serious impediments to making the undertaking pay; both the ore and the flux are at present brought by pack animals along hill roads, the former 24 miles from Chaita, and the manufactured iron is 24 miles from the nearest railway.

16. At Kángra, again, where are far the most important of the mines hitherto worked, attempts have from time to time been made to develop the industry. Most of the mines are in somewhat inaccessible localities; the approach to those in the Chota Bangáhal Valley is by a foot-track over the Solebtar pass; height about 10,000 feet; but a moderate expenditure would, it is said, make this good enough for mules. There are several others on the flanks and spurs of the Dhouladhar range, 5 or 6,000 feet above the sea, but more conveniently situated as regards the Kángra Valley cart-road.

17. Regarding the quantity of ore procurable, Dr. Warth estimates an outcrop in the Bangáhal Valley, more or less continuous, over a distance of 4 miles from Khod to Diot; but nowhere did the workable seam appear more than 2 feet thick; and 1 foot of good ore might be taken as the standard. The mines were mostly open quarries, without any true mining, but occasionally real mines had been worked to some depth, although the risk from falling in was considerable and accidents frequent. Good seams of the kind often repeat themselves; and Dr. Warth in a calculation assumes that as many as 10 miles of such seams might not be improbable, though the difficulties of transport to any common centre would be great. For the production of one maund of iron he estimates about 20 cubic feet of excavation as necessary, and that under favorable circumstances ore might be obtained from the supposed 10 miles of seams to furnish material on this scale for the

annual manufacture of about 1,100 tons of iron for 30 years. As will be hereafter explained, Von Schwarz would consider this total little more than sufficient for one year's economic working of an iron industry on any justifiable scale.

18. The cost of the iron as now manufactured, in rough lumps, is given at about Rs. 135 per ton in Kángra. It formerly realized about Rs. 216 per ton, but is now practically driven out of the market by the English iron. Improvements in the process of manufacture would probably materially reduce the cost.

19. The mountain sides in the Bangáhal Valley and the slopes of the Dhouladhar range in Kángra are covered with extensive forests of chil, rhododendron and oak, and under proper supervision there might be a future for charcoal-iron on a moderate scale here.

20. A railway is now in progress to Pathánkot, from whence the Kángra Valley cart-road provides a fair line of communication.

21. Detailed reports on the working and manufacture will be found in Colonel Paske's Report of 1873 and in Dr. Warth's pamphlet with some suggestions for the improved manufacture of charcoal-iron.

Iron : hills north of Peshá-war.

22. The iron of Bajáur in the hills north of Pesháwar has long been famous. The ore would appear to occur as a black magnetic iron, sand similar to that in the Lower Himalayas, and the iron to be obtained by a somewhat similar process. It is mentioned by Mr. Powell as selling in Pesháwar at from Rs. 81 to Rs. 162 per ton, and is said to be in great demand in Kabul, to be used in the manufacture of match-locks in Kandahar ; and in Kashmír to command three times the price of locally made iron. The greatest quantity is reported at a place called Burowl ; but, regarding the extent to which the ore is obtainable or the cost of manufacture, no information is available. No coal of any kind has ever been reported.

Iron : Sulemán range.

23. On the western frontier the information regarding the iron and coal of the Sulemán range and hills between the Punjab and Afghánistán is but scanty. From Kanigorum in the Wazíri hills iron is largely exported to Kabul, and large supplies are, or at some time were, drawn for Dera Gházi Khan. The ore is described as a brown hæmatite.

24. Some observations were made by Dr. Stewart, who accompanied the Waziri expedition in 1860, and during several days' march observed evidence of iron manufacture. It was also reported on by Dr. Verechere in 1867, and some account is given in Mr. Powell's Punjab Products, but it does not seem that any competent observer has yet visited the mines, and there is no information as to their extent.

25. Specimens of similar ores have also been obtained at Bajáur and other points on this frontier, but so far nothing of any value.

Coal.

26. On the eastern slopes of the Sulemán range nummulitic limestones (of the eocene period) occur, mixed with sandstones and shales underlying, and in these shales some thin seams of coal are occasionally found. In the Chamar-

lang Valley, about 75 miles west of Dera Gházi Khan, some specimens of good quality were found; and in 1874 Mr. Ball, of the Geological Survey, was deputed to visit and report; he however found no seams exceeding 9 inches in thickness, and all had a very rapid dip. The majority discovered were small beds 2 or 3 inches thick, and he reported none as having any commercial value.

27. A poor hard lignite has been found at one or two places in the Dera Ghází and Dera Ismail Khan Districts.

Coal and iron: Wazíri hills.

28. In the Wazíri hills, at the above-mentioned Kanigorum, coal, as well as iron, has been reported. From the description of its nature and position, it would seem to be somewhat similar in character to that at Chamarlang. One seam is stated to be about 3 miles east of the village of Luagar Khel, and this or adjacent localities have been referred to by various observers; but there is nothing to show the extent to which coal exists, and the geological probabilities are against any considerable deposit, while the situation would heavily handicap any possible industry.

29. With the exception of this place, concerning which it might be worth while when opportunity offers to institute further inquiries, there would appear to be but little hope of either coal or iron in this portion of the Province.

Iron: Arvali range.

30. In the southern part of the Province the only hills are those at the commencement of the Aravali range, and of Mahrauli on the borders of the Delhi District, and at two places, Jhir and Paton-Odepuri of the Firozpur Tahsíl in the Gurgaon District, the existence of iron has been long known, and smelting was described there half a century ago by Captain Boileau. Before the Firozpur Tahsíl was annexed in 1836, charcoal-iron smelting seems to have been carried on on a somewhat extensive scale by native agency. Mr. Channing writes that there were then some 22 or 23 smelting-furnaces in Firozpur, each capable of turning out 2 maunds of iron in 18 hours. In full work this would have represented an outturn of 2 tons per day. About 7 maunds of iron-stone and 6 maunds of charcoal (then valued at Re. 1) were required for each maund of iron, the cost of manufacture being put at about Rs. 63, and the selling price about Rs. 81 per ton.

31. The adjoining hills were formerly clothed with thick dhak jungle, from which the charcoal was made, the jungle being conserved for the purpose; but after annexation the mines and the hills were made over to the various villages, the jungle was quickly denuded, and the manufacture, being unremunerative, was abandoned. The ore is a fairly rich brown hæmatite (hydrous peroxide), and is found close to the surface, but there is no information as to the extent of the deposit.

32. In September 1874 His Honor the Lieutenant-Governor expressed a wish to have the iron localities of this district examined and reported on by an Officer of the Geological Survey, but it does not appear that this was done. The position of the mines is advantageously situate with reference to Railway transport; but there is no prospect of any fuel except imported coal.

Salt Range.

33. Having thus made the circuit of the Province, it remains only to notice the Salt Range and minor hills of the Sind Ságar Doáb in the north. The iron and coal of the Salt Range have, for many years, attracted notice, and hopes of useful supplies of both have, from time to time, been raised, only to be disappointed when full investigation came to be made.

Iron.

34. It is now pretty generally accepted that the Salt Range possess no iron ore of any consequence. The whole range has been closely examined with this view by several competent observers, notably by Dr. Flemming and Mr. Wynne, who both reported unfavorably. The latter very fully examined the range from one end to the other, including the Trans-Indus extension; and the results are given *in extenso* in the Geological Memoirs (Nos. XI. of 1876, XIV. of 1878, and XVII. of 1880).

35. The only known ore consists of some nodules of earthly hæmatites found in one or two places as at Mukrach and Karauli, and by repute more extensively about 30 miles south-east of Bannu in the Trans-Indus part of the range. This ore is said to be in considerable demand at Kálabágh for making nails, cooking utensils, &c., but curiously there is no mention whatever of any such mines in Mr. Wynne's monograph of these hills (1880).

Iron : Kerána hills.

36. In the detached barren range of hills called Kerána iron undoubtedly exists; and in an isolated hill called Kot Kerána, just within the boundary of the Jutch District, Dr. Flemming reported an abundant supply of hæmatite, and some experimental metal has since been produced. This hill, height about 1,000 feet, the highest point of a small ridge rising most abruptly from the plain, is mainly a coarse brown ferrugineous sandstone traversed by veins of white quartz containing a mass of rich ore which he estimates to yield 70 or 80 per cent. of metal, and obtainable in considerable quantities, but which does not seem to have attracted much attention as a source of iron. Dr. Flemming mentions also a peroxide of manganese as also obtained. An account of Dr. Flemming's investigation will be found in No. X. of the Punjab Selections of 1854, but the locality does not seem to have been specially examined by any Officer of the Geological Survey.

Coal : Salt Range.

37. As regards the very little Salt Range coal that has caused so much cry, almost every spot exhibiting traces of carbonaceous matter has been examined and reported on. As early as 1833, Lieutenant, afterwards Sir A. Burnes, submitted a report on what was supposed to be coal from near Kohát, and among the principal of the subsequent ones may be instanced Dr. Flemming's in 1853, M. Marcadien's in 1855, Colonel Taylor's on the Kálabágh coal in 1863, Dr. Oldham's in 1864, Dr. Verechere's in 1867, Mr. Lyman in connection with the petroleum exploitation in 1873, and Mr. Wynne's elaborate geological monographs in 1878 and 1880. It would be useless to attempt to follow and correlate the observations of all of the above, as the gist of the matter has already been given in Mr. Powell's Punjab Products and subsequently in Mr. Ball's volume of Economic

Geology published in 1881. The localities referred to by Messrs. Flemming, Marcadien, Taylor and Oldham have been shown on a small sketch map, No. 3, accompanying.

38. The substance of these reports shows that an inferior coal or lignite occurs at 18 or 20 localities ; but at only a few in any workable quantity. Several mines have been opened, and though the mineral has been used, it has generally been reported on unfavorably for economic purposes. In a few cases a fair quality has been obtained, but the quantity very small and usually deteriorated by admixture with the inferior quality from the adjoining beds. A good deal is not coal but lignite, a structure something between fossilized wood and coal, containing much sulphur and iron pyrites, rapidly disintegrating when exposed to the atmosphere, and very liable to spontaneous combustion. It burns quickly without coking, with a large quantity of inflammable gas and large proportion of ash ; so would appear to be ill adapted for smelting purposes, but as a fuel would, no doubt, compare favorably with wood. Experiments showed that for locomotive engines and steamers one maund was equal to 2½ to 4 maunds of wood.

39. The mineral is found, but only in detached masses, in two geological series, in the shales and sandstones of the jurassic or oolitic beds confined to the western portion of the range, which, as regards quality, is the best, and in the eocene beds of the tertiary series in which seams have occasionally been found 3 to 4 feet thick.

40. Geological authorities offer a theory to account for the difference between the extent of the carbonaceous deposits in these tertiary rocks and those found to a considerable extent in similar rocks in North-Eastern India, to the effect that the present climatic condition of the Punjab of little rain-fall and sparse vegetation, if existing in tertiary times, would have been sufficient to account for the absence of the materials that in Assam contributed to the formation of large seams of coal. The theory savours somewhat of begging the question as regards the Punjab climate in such very prehistoric times ; but so far as research has yet gone, nothing beyond thin seams, or the most limited nests of either coal or lignite, have been discovered in the tertiary rocks of the Salt Range.

41. An attempt to estimate the quantity was made by Dr. Oldham, and the following précis from his memorandum will give a general idea of the result :—

Trans-Indus.—In the older jurassic rocks.

Mullakhel.—Irregular strings and nests in many places in the alum shales.

Kotki.—Beds containing coaly matter at the south end of the Chichâli Pass.

Kálabágh.—Carbonized masses of wood in alum shales. Possibly 45,000 maunds could be obtained.

Cis-Indus.—Jurassic and tertiary.

Amb—Coal of no value and of limited extent.

Sunglewa.—Two thin seams of 6″ and 10″ respectively ; dip 30° ; could not be profitably worked.

At Chámil Kutta and four others, coal, originally of very limited extent and mostly worked out.

Nila.—Poor coal, 15 inches thick, dip 30°, and 8 feet of blackish shales with thin layers.

Dandot.—At three localities the thickest 2½ feet thick. Fuel not bad, but no profitable quantity.

Pid.—Seam of good quality ; in places 3 feet thick ; dip 600°. From this and a place called Samundie about 2,000 tons were extracted between 1863 and 1867.

Khewra.—A seam 3 feet thick, but very inferior, and mixed with shale.

Bhagwála—An outcrop 3 feet 6 inches thick, extending for a distance of 2 miles, dip 63°. Dr. Oldham estimates the total amount available here at 1,620,000 maunds. This may be taken as the most promising of the series, and, deducting the necessary percentage of waste, a favorable estimate might assume 40,000 or 50,000 tons of fuel. The examination, however, tends to show that such deposits exist generally, though not continuously, along the range, more especially towards the east, and further examination might result in the discovery of similar beds in other places possibly now concealed by the *débris* that has fallen from the associated rocks above. At the same time the soft shaly nature of these rocks, combined with the fact that the coal beds are generally overlaid by a hard nummulitic limestone, will always render prospecting both difficult and costly.

Coal : Chitta Pahar Range.

42. In the Chitta Pahar Range, which connect the mountains of southern Hazára with the Sufaid Koh, the tertiary rocks are again exposed, though there is said to be a marked distinction between the character of the groups and those of the Salt Range. Mr. Ball points out that carbonaceous beds underlying the nummulitic series can be traced in many places, and that these locally include nests of light coal. Attention has again been recently called to the subject by the Engineers of the Punjab Northern Railway. Mr. Johnson of the Attock bridge, in a recent report, is disposed to attach great value to some beds examined by him at Chir, Shujandhar, Dheri and Baguilab. He speaks of seams 5 to 8 feet thick at a depth of from 50 to 60 feet from the surface, but which the presence of water prevented his exploring further ; that he has already used some 1,500 to 2,000 tons on the Railway works and supplied 10 tons for the gas works at Ráwalpindi with the most favorable results in the production of gas. The matter is now under investigation by order of the Government of India, but it appears the strata has so steep a dip as to be almost perpendicular, and it will not unlikely be found these figures do not represent the thickness of the beds, but the mines

are mere pockets of no great extent. The mineral, of which a sample has been received, has every appearance of the inferior Salt Range lignites, and from Mr. Johnson's description of its rapid disintegration is apparently of much the same character.

43. As regards the prospect of any iron industry in either of these two ranges, it may be said, with the single exception of the isolated hill at Kot Kerána, there is no iron, and any coal is not only poor in quality, but so insignificant in quantity, it might be left out in considering the feasibility of *any* industry on a large scale.

Conditions for successful iron industry.

44. The first of Mr. Molesworth's conditions for a successful iron industry is, that the manufacture must be on a sufficiently large scale, and it may be of interest to briefly notice what that required scale would be for works in India. In the case of Bengal, this has recently been done by Ritter Von Schwarz. He points out that not only must works be on a large scale, but for the manufacture of wrought-iron in the form of rails, girders or other heavy rolled iron or steel goods to be successful, as large a quantity as possible must be produced in a given time, in order to distribute the inseparably heavy expenses for workmen and supervision over a great outturn.

45. In England and America the average outturn of a *single* rail-rolling mill is about 440 tons of finished rails per 24 hours, and, exceptionally, in making double headers of 80 lbs. per yard, 600 tons have been turned out in the same time. Von Schwarz bases his calculations for the Bengal iron-works on the modest outturn of 200 tons of rolled goods per day, and estimates the cost of a single rail-rolling mill at Barrakár at 24½ lakhs, *viz* :—

	Rs.
Furnaces and machinery	14,14,000
Buldings and earth-works	5,80,500
Tramways and Railways	1,70,000
Bringing out 70 Europeans..	35,000
Working capital	2,50,000
	24,49,500

With a factory on this scale in *full work* he estimates Bessemer iron rails might be turned out Rs. 19 per ton and steel rails Rs. 28 per ton cheaper than similar goods can be obtained from England at Barrakár. At any point nearer the sea this small saving, which depends on fluctuating prices, diminishes. It would increase the greater the distance the manufactory was from the nearest port, and so obviously would the cost of machinery, &c., and the cost of a similar mill would be materially increased in the Punjab.

46. The Bengal iron-works were originally constructed with two blast-furnaces capable of producing 40 ton of grey pig-iron or castings every 24 hours. If they are to be profitably re-opened, Von Schwarz recommends arrangements to be made to raise the production of cast-iron to 80 tons, sufficient to produce cast-iron sleepers for about ½ a

mile of broad gauge lines per day. To do this he estimates the improvements and repairs to the existing works at Rs. 6½ lakhs, to which would have to be added the value put on existing property, about Rs. 4½ lakhs. When this Company first opened in 1875, they produced pig-iron at a cost of Rs. 65 per ton, English pig selling in Calcutta at Rs. 60. In two years the Company succeeded in bringing down the cost to Rs. 40, but English pig-iron had fallen to Rs. 29. Its present price in Calcutta is Rs 35, and of cast-iron sleepers about Rs 59 per ton. Von Schwarz estimates with his proposed improvements and keeping up the steady outturn of 80 tons per day, the cost of pig-iron might be brought down to Rs. 25, and of cast sleepers to Rs. 47 per ton, but this is excluding the important factor of interest on capital. English prices at Barrakár would run about Rs. 47 and Rs. 65 respectively, so that the difference of the Bengal made castings would be about Rs 13 and Rs. 18 per ton cheaper, less charges for interest, &c., say Rs. 3 to Rs. 4 per ton.

47. This is under peculiarly favorable circumstances in Bengal with the raw material, a rich iron ore, a limestone for flux, and good coal, all close together in unlimited quantities, the Barrakár river alongside, and an existing railway connecting the works with the main trunk line.

48. Owing to the increased land carriage on imported iron work, a Punjab manufacturer would be able to take a considerable higher rate for comparison, but in every other respect he would be at a very serious disadvantage.

49. It may therefore be said that, as far as our present information goes, neither fuel not iron could be concentrated in sufficient quantities at any spot in this Province to render a large iron industry of commercial possibility.

50. Charcoal-iron of superior quality might, by careful supervision, be produced at Kángra and some other localities in the Sub-Himalayas at remunerative rates. To a more limited and doubtful extent at one or two other sites. And concerning some other, as Bajáur, Kanigorum, Kot Kerána, and the Gurgaon District, further inquiries would at least be of interest.

(Sd.) E. E. OLIVER,

26*th March* 1883.

Enclosure.

1. Map of Punjab showing localities of coal and iron with reference to principal mountain ranges.
2. Plan of Salt Range showing ditto.
3. Sketch map of part of Kángra Valley and Bangáhal Valley.

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